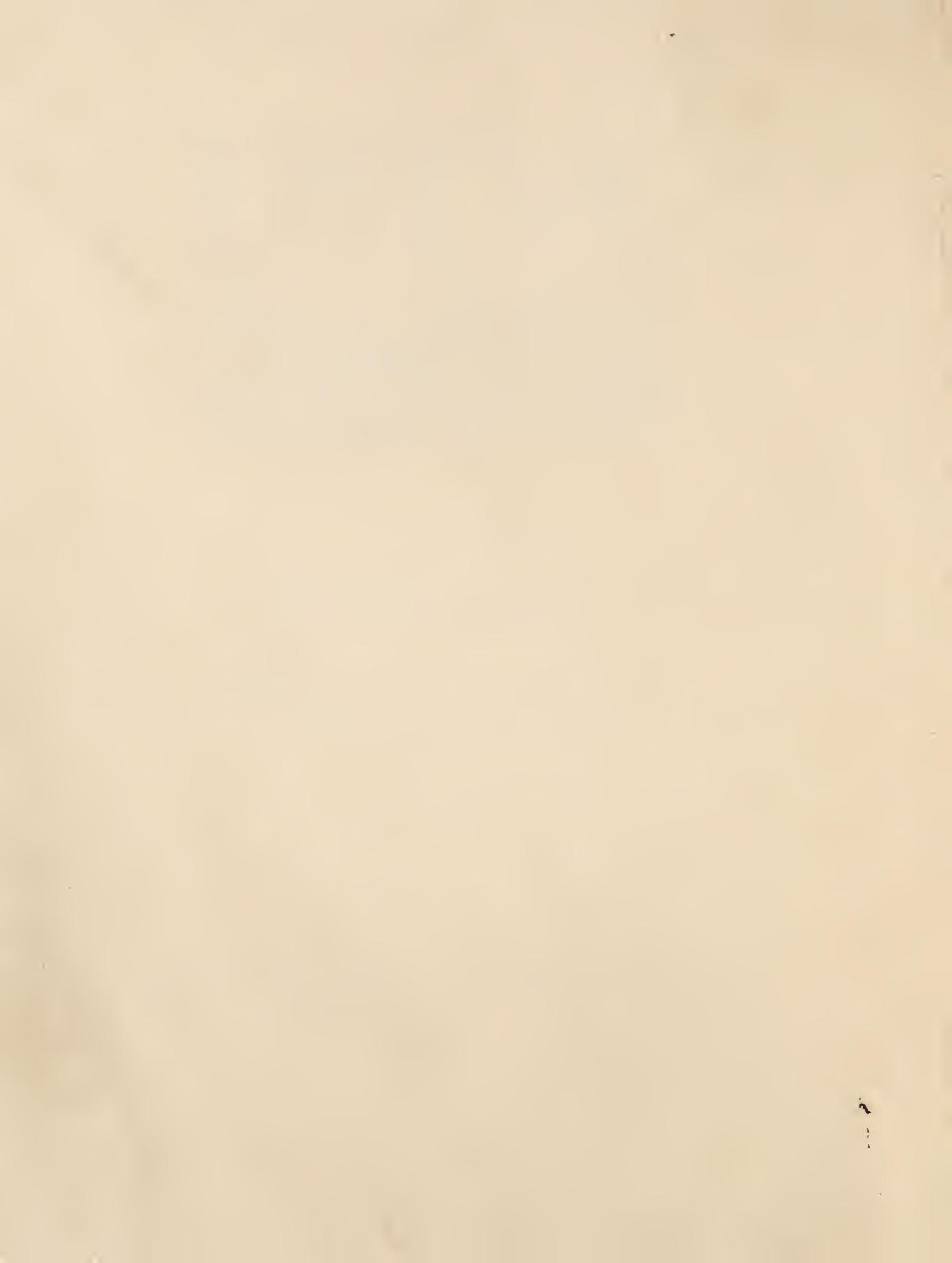


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Rob. ex Desm. f. sp. *tritici*

in the United States in 1962 and 1963

Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

Physiologic Specialization of Puccinia recondita Rob. ex Desm. f. sp. tritici in the United States in 1962 and 1963¹

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Physiologic race analyses were made at Manhattan, Kans., from uredial collections of wheat leaf rust, caused by Puccinia recondita Rob. ex Desm. f. sp. tritici. The collections were made in the field in various parts of the United States in 1962 and 1963 and sent to Manhattan where they were stored in a refrigerator at 2 to 5° C. from the time of receipt to about September 1.

Cultures were established by inoculating Triticum aestivum L. 'Bison' (C.I. 12518) seedlings with spores from the collections by a scalpel method similar to that outlined by Johnston and Mains (5)³ and then subjecting the inoculated plants to a 16- to 18-hour moist period at temperatures ranging from 15 to 25° C. Some of the collections apparently were nonviable, since no rust developed from some inoculations. At least one more attempt was made to establish cultures from most of the collections that did not develop rust from the first inoculation.

The number of pustules in each culture varied greatly. In some cultures only a single uredium was obtained, whereas in others more than 100 were obtained. If fewer than five uredia developed, all were isolated as single-pustule isolates, but only four isolates were made from cultures having more than four pustules. The scalpel method was also used in making the single-pustule isolates. Each isolate was used to brush inoculate (5) a set of the International Standard differential varieties (2). The infected differential sets were placed in greenhouses heated to 16 to 20° C. However, sometimes temperatures were higher since no cooling was provided. Physiologic race determinations were made from the reaction types of 10- to 12-day-old infections.

The Unified Numeration race system devised by Basile (1) was used to group the races. This system uses five of the eight International Standard differential varieties. Basile proposed the system because of the temperature sensitivity of the other three varieties. Thus, Unified Numeration (UN) races are essentially groupings of races as determined by the International Standard set. Grouping of similar standard races into UN races reduces the number of units and combines standard races that differ only slightly into large, sharply contrasted groups. The grouping of the 26 constituent races identified into UN races is shown in table 1, along with the reactions of the UN race differential varieties to each UN race identified.

¹ Cooperative investigations of the Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, and the Kansas Agricultural Experiment Station, Manhattan, Department of Botany and Plant Pathology Contribution No. 646.

² Crops Research Division, Agricultural Research Service.

³ Underscored numbers in parentheses refer to Literature Cited, at end of report.

TABLE 1.--Constituent races and reaction of 5 differential varieties to UN races of *Puccinia recondita* f. sp. *tritici* isolated in the United States in 1962 and 1963

[R = resistant; S = susceptible]

UN race	Constituent races	Reaction of--				
		Malakof	Webster	Loros	Mediterranean	Democrat
1.....	1, 53	R	R	R	R	R
2.....	2, 15	R	R	R	S	S
3.....	12, 58, 61, 84, 141	R	R	S	S	S
5.....	5, 52	S	R	R	S	S
6.....	6, 105, 144	S	R	S	S	S
9.....	9, 10, 13, 19, 20, 31	S	S	S	R	R
10.....	11, 26	R	R	S	R	R
13.....	35, 77, 122	S	S	S	S	S
17.....	143	R	S	S		

1962 Survey

During 1962, cultures were obtained from 287 field collections from 27 States, representing most of the important wheat-producing sections of the country. In all, 1,039 single-pustule isolates, or approximately 3.6 isolates per culture, were made. Eight UN races were present; the numbers of isolates of each from the various States are shown in table 2.

UN race 2 (standard races 2 and 15) was most abundant and most widely distributed, comprising 47.8 percent of all isolates and appearing in all but two States, and remained the most important UN race in the United States for the sixth consecutive year.

UN race 9 (principally standard races 9, 19, and 20) was the second most important, comprising 25.8 percent of all isolates. This represents a slight increase in prevalence from that of the 1961 analysis (4). UN race 13 (standard races 35, 77, and 122) was third most prevalent. It was particularly abundant in Kansas, Texas, Illinois, Georgia, and Minnesota.

Other UN races were important only in certain areas and States. For example, UN race 5 (standard races 5 and 52) was important in the hard red winter wheat- and hard red spring wheat-growing areas, but was of little importance elsewhere.

UN races 1 (standard races 1 and 53) and 10 (standard races 11 and 26) were more prevalent in the Southeastern States than elsewhere. In previous years they have been most abundant in the Pacific Northwest and California.

The number of isolates of each standard physiologic race from the different States is shown in table 3.

TABLE 2.--Number of isolates of each UN race of Puccinia recondita f. sp. tritici identified from collections of wheat leaf rust made in the United States in 1962

Wheat region and State	Number of isolates of UN race--								Total		
	1	2	3	5	6	9	10	13	Cultures	Races	Isolates
<u>Northern soft red winter:</u>											
Illinois.....	-	22	5	1	-	7	-	10	12	5	45
Indiana.....	-	5	4	-	-	1	-	1	4	4	11
Maryland.....	-	3	13	-	-	8	-	2	7	4	26
Michigan.....	-	10	5	-	1	2	-	-	6	4	18
Missouri.....	-	1	1	1	1	5	-	4	4	6	13
New Hampshire....	-	1	2	-	-	-	-	4	2	3	7
New York.....	-	-	3	-	1	-	1	-	1	3	5
Ohio.....	-	-	4	-	-	1	-	1	2	3	6
<u>Southern soft red winter:</u>											
Alabama.....	-	14	1	-	-	2	7	1	9	5	25
Arkansas.....	-	21	-	-	-	3	-	3	8	3	27
Florida.....	3	3	4	1	-	6	-	3	5	6	20
Georgia.....	-	17	-	-	-	7	-	7	11	3	31
North Carolina...	-	7	-	-	-	-	-	-	2	1	7
South Carolina...	-	5	-	1	-	1	-	1	3	4	8
Virginia.....	-	2	-	1	-	2	-	-	1	3	5
<u>Hard red winter:</u>											
Kansas.....	-	120	1	15	-	123	1	48	76	6	308
Nebraska.....	-	23	-	4	-	6	-	4	9	4	37
Oklahoma.....	-	6	4	1	-	7	-	-	7	4	18
Texas.....	1	74	10	21	4	40	-	19	46	7	169
Wyoming.....	-	14	-	4	-	4	-	1	5	4	23
<u>Hard red spring:</u>											
Iowa.....	-	19	-	3	1	6	-	2	11	5	31
Minnesota.....	1	57	1	5	-	12	-	6	22	6	82
Montana.....	-	2	-	2	-	-	-	-	1	2	4
North Dakota.....	-	35	-	5	1	6	-	1	14	5	48
South Dakota.....	-	8	-	1	-	5	-	-	6	3	14
Wisconsin.....	-	28	1	-	6	7	1	1	11	6	44
<u>White wheat:</u>											
Washington.....	-	-	-	-	-	7	-	-	2	1	7
<u>Total.....</u>	5	497	59	66	15	268	10	119	287	8	1,039
<u>Percentage of isolates.....</u>	0.4	47.8	5.7	6.4	1.4	25.8	1.0	11.5	-	-	-

TABLE 3.--Standard physiologic races of Puccinia recondita f. sp. tritici and the number of isolates of each obtained from collections of wheat leaf rust made in the United States in 1962

State	Physiologic races and, in parentheses, number of isolates
Alabama.....	2(14), 20(2), 26(7), 61(1), 77(1)
Arkansas.....	2(16), 15(5), 19(1), 20(2), 122(3)
Florida.....	2(3), 5(1), 20(6), 53(3), 77(3), 84(4)
Georgia.....	2(7), 9(4), 15(10), 20(3), 77(6), 122(1)
Illinois.....	2(16), 9(2), 15(6), 19(3), 20(2), 35(2), 52(1), 61(3), 77(5), 84(1), 122(3), 141(1)
Indiana.....	2(3), 15(2), 20(1), 58(4), 122(1)
Iowa.....	2(6), 9(1), 15(13), 20(5), 52(3), 77(1), 105(1), 122(1)
Kansas.....	2(94), 5(4), 9(2), 11(1), 15(26), 19(16), 20(105), 52(11), 77(39), 84(1), 122(9)
Maryland.....	2(3), 12(2), 20(8), 61(1), 77(2), 141(10)
Michigan.....	2(6), 6(1), 15(4), 20(2), 58(2), 84(3)
Minnesota.....	1(1), 2(33), 5(1), 15(24), 19(1), 20(11), 52(4), 58(1), 77(6)
Missouri.....	5(1), 6(1), 15(1), 19(4), 20(1), 58(1), 77(1), 122(3)
Montana.....	2(2), 52(2)
Nebraska.....	2(17), 5(2), 15(6), 19(1), 20(5), 35(1), 52(2), 77(3)
New Hampshire.....	2(1), 58(2), 77(4)
New York.....	6(1), 11(1), 58(3)
North Carolina.....	2(7)
North Dakota.....	2(25), 5(2), 6(1), 15(10), 19(1), 20(5), 52(3), 77(1)
Ohio.....	12(4), 20(1), 77(1)
Oklahoma.....	2(4), 12(4), 15(2), 19(1), 20(6), 52(1)
South Carolina.....	2(5), 20(1), 52(1), 77(1)
South Dakota.....	2(8), 9(1), 20(4), 52(1)
Texas.....	1(1), 2(49), 5(6), 6(1), 9(4), 15(25), 19(9), 20(27), 35(2), 52(15), 61(7), 77(10), 84(1), 105(1), 122(7), 141(2), 144(2)
Virginia.....	2(2), 5(1), 20(2)
Washington.....	20(7)
Wisconsin.....	2(17), 6(5), 15(11), 19(3), 20(4), 26(1), 84(1), 105(1), 122(1)
Wyoming.....	2(9), 5(2), 15(5), 20(4), 52(2), 122(1)

1963 Survey

During 1963, 480 collections were received from 21 States. Of these, 378 were made during the spring growing season of the 1962-63 wheat crop, and 102 were made in four States in the fall, principally on winter wheat in Kansas. Only 244 cultures were obtained from the spring collections, and 96 from the fall. From the spring cultures, 658 isolates were made; from the fall cultures, 382. Basile's UN race system (1) was again used to group the physiologic races identified (table 1).

Results of the analysis of 1963 spring collections are in table 4. As in other recent years, (3, 4) UN race 2 was most abundant and was widely distributed; it was identified from all States for which cultures were obtained. The trend for this UN race to increase continued; it comprised 67.0 percent of all isolates from the 1963 spring cultures, as compared with 44.4 percent, 39.1 percent, and 47.9 percent in 1960, 1961, and 1962, respectively. Much of the increase in 1963 undoubtedly was due to the screening effect of the widely grown Selkirk spring wheat for some isolates within this UN race grouping. This effect is due to two factors. First, virulence

TABLE 4.--Number of isolates of each UN race of Puccinia recondita f. sp. tritici identified from collections of wheat leaf rust made during the spring growing season in the United States in 1963

State	Nonviable collections	Number of isolates of UN race--							Total	
		2	3	5	6	9	13	17	Cultures	Isolates
Colorado.....	23	2	-	-	-	4	1	-	6	7
Florida.....	4	5	-	-	-	2	-	-	6	7
Georgia.....	1	7	3	-	-	1	-	-	7	11
Illinois.....	7	7	1	-	2	-	-	-	6	10
Iowa.....	0	35	-	1	-	-	-	-	10	36
Kansas.....	23	180	-	21	-	125	3	-	98	329
Maryland.....	1	-	-	-	-	-	-	-	0	0
Michigan.....	6	20	4	1	-	1	-	-	9	26
Minnesota.....	4	80	-	9	-	3	1	5	37	98
Missouri.....	14	11	-	1	-	1	-	-	6	13
Nebraska.....	0	4	-	-	-	-	-	-	1	4
New York.....	4	1	-	-	-	-	-	-	1	1
North Dakota.....	11	17	1	-	-	3	1	-	11	22
Ohio.....	3	11	6	-	-	1	-	-	6	18
Oklahoma.....	1	-	-	-	-	-	-	-	0	0
South Carolina...	3	1	-	-	-	1	-	-	2	2
South Dakota.....	4	1	-	1	-	-	-	-	2	2
Tennessee.....	2	-	-	-	-	-	-	-	0	0
Texas.....	22	40	1	-	-	8	-	-	27	49
Wisconsin.....	1	9	-	3	-	1	-	-	5	13
Wyoming.....	0	10	-	-	-	-	-	-	4	10
Total.....	134	441	16	37	2	151	6	5	244	658
Percentage of isolates.....	-	67.0	2.4	5.6	0.3	22.9	0.9	0.8	-	-

to Selkirk occurs commonly within this UN race; whereas it is rare in others. Second, the variety is widely grown; therefore, more collections are made from it than from other varieties.

UN race 9 continued as the second most prevalent UN race, comprising 22.9 percent of the isolates. This UN race was particularly abundant in cultures made from Kansas collections. Sampling differences or the aggressiveness characteristics of UN race 9 as suggested by Johnston and Mains (5) might be the reasons for its abundance in cultures made from Kansas collections.

UN race 5 comprised only 5.6 percent of the 1963 spring isolates but was the third most prevalent UN race. Still fewer isolates of UN race 13 were found. They comprised only 0.9 percent of all isolates in 1963 even though they had increased in prevalence to 11.5 percent in 1962. Other races were rare, and UN race 10 was not identified in the 1963 analysis.

Results of the analysis of 1963 fall collections, made in only four States, are in table 5. On the basis of the UN differential set, results for the fall collections were essentially the same as those for the 1963 spring collections. One feature of the spring and fall analyses, however, was the differences in prevalence of UN race 9. In the spring cultures from Kansas, UN race 9 comprised 38.0 percent of the isolates; this UN race comprised only 13.6 percent of the isolates

TABLE 5.--Number of isolates of each UN race of Puccinia recondita f. sp. tritici identified from collections of wheat leaf rust made during the fall growing season in the United States in 1963

State	Nonviable collections	Number of isolates of UN race							Total	
		2	3	5	6	9	13	17	Cultures	Isolates
Kansas.....	5	236	1	19	1	108	-	5	90	370
Minnesota.....	0	9	-	1	-	-	-	-	3	10
Nebraska.....	0	9	-	3	-	-	-	-	3	12
Oklahoma.....	1	-	-	-	-	-	-	-	0	0
Total.....	6	254	1	23	1	108	0	5	96	392
Percentage of isolates.....	-	64.8	0.25	5.9	0.25	27.5	0	1.3	-	-

from North Dakota and 3.1 percent from Minnesota. In contrast, UN race 9 comprised 29.2 percent of the total isolates in the Kansas fall cultures. Since spores from the spring wheat area provide inoculum for primary infections in Kansas during the fall, this again points to the possibility of aggressiveness in UN race 9. Sampling error may be involved; however, the trend seems worthy of further study.

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